Cell and Tissues

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Introduction

The **cell** (from Latin *cellula* 'small room) is the basic structural, functional, and biological unit of all known organisms. A cell is the smallest unit of life.

Therefore, cells are often described as the "building blocks of life".

Cells consist of cytoplasm enclosed within a membrane, which contains many biomolecules such as proteins and nucleic acids. Most plant and animal cells are only visible under a light microscope, with dimensions between 1 and 100 micrometres. Electron microscopy gives a much higher resolution showing greatly detailed cell structure. Organisms can be classified as unicellular (consisting of a single cell such as bacteria) or multicellular (including plants and animals).Most unicellular organisms are classed as microorganisms.

The number of cells in plants and animals varies from species to species; it has been approximated that the human body contains roughly 40 trillion (4×10^{13}) cells. The brain accounts for around 80 billion of these cells.

Cells were discovered by Robert Hooke in 1665, who named them for their resemblance to cells inhabited by Christian monks in a monastery. Cell theory, first developed in 1839 by Matthias Jakob Schleiden and Theodor Schwann, states that all organisms are composed of one or more cells, that cells are the fundamental unit of structure and function in all living organisms, and that all cells come from pre-existing cells. Cells emerged on Earth about 4 billion years ago.

Types of Cells

Cells are of two types: eukaryotic, which contain a nucleus, and prokaryotic cells, which do not have a nucleus, but a nucleoid region is still present. Prokaryotes are single-celled organisms, while eukaryotes can be either single-celled or multicellular.

Prokaryotic cells

A **prokaryote** is a typically unicellular organism that lacks a nuclear membrane-enclosed nucleusThe word *prokaryote* comes from the Greek πρό (*pro*, 'before') and κάρυον (*karyon*, 'nut' or 'kernel' In the two-empire system arising from the work of Édouard Chatton, prokaryotes were classified within the empire **Prokaryota**. But in the three-domain system, based upon molecular analysis, prokaryotes are divided into two domains: *Bacteria* (formerly Eubacteria) and *Archaea* (formerly Archaebacteria). Organisms with nuclei are placed in a third domain, Eukaryota. In the study of the origins of life, prokaryotes are thought to have arisen before eukaryotes.

Prokaryotes lack mitochondria, or any other eukaryotic membrane-bound organelles; and it was once thought that prokaryotes lacked cellular compartments, and therefore all cellular components within the cytoplasm were unenclosed, except for an outer cell membrane. But bacterial microcompartments, which are thought to be simple organelles enclosed in protein shells, have been discovered, along with other prokaryotic organelles. While typically being unicellular, some prokaryotes, such as cyanobacteria, may form large colonies. Others, such as myxobacteria, have multicellular stages in their life cycles. Prokaryotes are asexual, reproducing without fusion of gametes, although horizontal gene transfer also takes place.

Molecular studies have provided insight into the evolution and interrelationships of the three domains of life. The division between prokaryotes and eukaryotes reflects the existence of two very different levels of cellular organization; only eukaryotic cells have an enveloped nucleus that contains its chromosomal DNA, and other characteristic membrane-bound organelles including mitochondria. Distinctive types of prokaryotes include extremophiles and methanogens; these are common in some extreme environments.

History of Cells

The distinction between prokaryotes and eukaryotes was firmly established by the microbiologists Roger Stanier and C. B. van Niel in their 1962 paper The concept of a bacterium (though spelled procaryote and eucaryote there). That paper cites Édouard Chatton's 1937 book *Titres et Travaux Scientifiques*[for using those terms and recognizing the distinction. One reason for this classification was so that what was then often called blue-green algae (now called cyanobacteria) would not be classified as plants but grouped with bacteria.

Cell Theory

- The cell is the basic functional and structural unit of life. All the living organisms are composed of cells.
- All cells are formed by the division of the already existing cells which in terms of biology means reproduction. Every cell of our body comprises of genetic material which is passed down during the process.
- All the basic physiological and chemical functions i.e. the growth, repair, movement, communication, immunity and digestions are performed inside the cells.
- All the activities of the cell depend mainly on the activities of the subcellular structures that lie within the cell. These subcellular structures comprise of the plasma membrane, organelles and if present, the nucleus.

Here is the revised introduction to cell. In all the living beings, cells are the basic structural units. We can compare the presence of cells in our body to the bricks in a building. All the bricks are assembled to make a building. Similarly, all the cells are assembled to make the body of an organism.

Thus, it is the basic structural and functional unit of life and all the organisms are made up of cells. The subcellular structures of the cell comprise of the plasma membrane, organelles and in some cases a nucleus as well. As for the size of the cell, it is variable and maybe anything from 1 to 100 micrometre.

How Are Cells Produced?

Every cell is produced by the division of a cell that is already existing in our body. This is possible because of the genetic material contained in the cell. The genetic material is passed down from one cell to another during the reproduction process. Unlike the non-living bricks, the cells of the living organisms are rather complex living structures. Therefore, the cells can divide the genetic material and form two new cells.

Types of Cell

Broadly, there are two key types of cells i.e. the Prokaryotic Cell and the Eukaryotic Cell. The difference between the two is defined mainly by the presence or the absence of the nuclear membrane. Let’s know more about the two types of cells.

1) Prokaryotic Cell

If a cell has a nuclear material without a nuclear membrane, then it is known as the prokaryotic cell.

Those organisms which have these type of cells are commonly known as the prokaryotes where ‘pro’ stands for primitive and ‘karyon’ stands for the nucleus. Some of the organisms that have prokaryotic cells include bacteria and the blue-green algae.

2) Eukaryotic Cell

If a cell has a nuclear material with a nuclear membrane, then it is known as the Eukaryotic Cell. Those organisms which have these type of cells are commonly known as eukaryotes where ‘eu’ stands for true and ‘karyon’ stands for the nucleus. All the living organisms except bacteria and blue-green algae have Eukaryotic Cells.

Functions of a Cell

As you already know that a cell is a structural and functional unit of living. Let us study 6 of the most vital functions performed by a cell.

Structure and Support

You know a house is made of bricks. Similarly, an organism is made up of cells. Though there are certain cells such as collenchyma and sclerenchyma are present for offering structural support however in general too, all cells generally provide the structural basis of all organisms.

Growth

In complex organisms such as humans, the tissues grow by simple multiplication of cells. Hence, cells are responsible for the growth of the organism. The entire thing takes place via a process of mitosis.

Transport

Cells import the nutrients that are used in the different chemical process which take place inside them. As a result of these processes, a waste product is produced. Cells then work to get rid of this waste. In this manner, the small molecules like the such as oxygen, carbon dioxide, and ethanol pass through the cell membrane by diffusion. This method is known as passive transport. On the other hand, the larger molecules like the proteins and polysaccharides, go in and out of the cell via active transport.

Energy Production

Organisms need energy to perform different chemical reactions. In plants, the energy comes from the process of photosynthesis while in the animals the energy comes via respiration.

Metabolism

Cell is responsible for metabolism that includes all the chemical reactions that take place inside an organism to keep it alive.

Reproduction

A cell helps in reproduction by the processes of mitosis (in more evolved organisms) and meiosis.

Different Cell Organelles and their Functions

Organelles make up the subunits of a cell. There are numerous each with their own function.

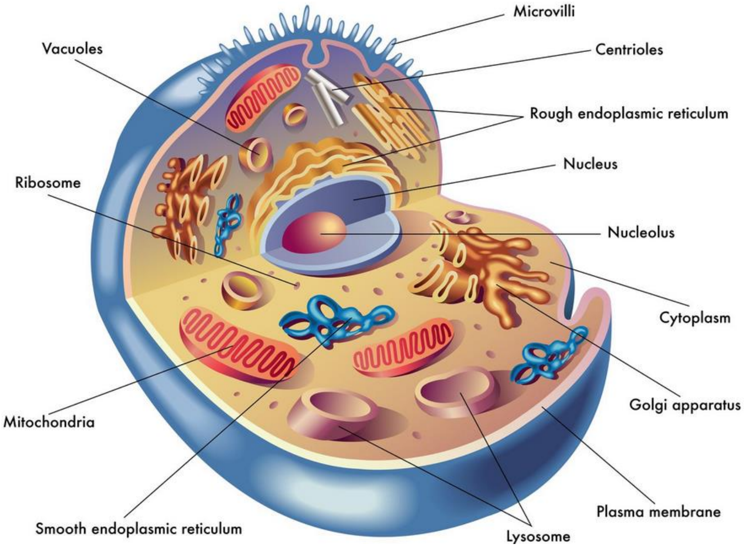


Fig. (1): Cell Organelles

Plasma Membrane

The plasma membrane is the organelle that encapsulates the contents of the cell. Apart from encapsulating cell contents, the plasma membrane also plays a vital role in regulating the movement of substances in and out of the cell.

As such, it is actively involved in such both passive and active transportation to and from the cell. These processes also help maintain balance even when conditions outside the cell change.

The plasma membrane is made up of two layers of phospholipids (phospholipids bilayer).

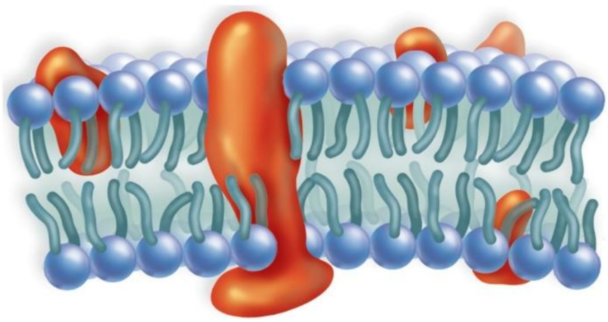


Fig. (2): The plasma membrane

<u>Nucleus</u>/<u>DNA</u>

Some of the main components of the nucleus include the chromatic, nucleoplasm/nuclear sap and the nucleolus. The nucleus houses DNA (the hereditary material) as well as various proteins and the nucleolus. In eukaryotic cells, the nucleus is enclosed in a nuclear membrane. It is the organelle that controls the hereditary traits of an organism by directing such processes as protein synthesis and cell division among others. For prokaryotes, the DNA lacks a nuclear membrane. The genetic material is therefore bound in the nucleotide region. The nucleolus plays an important role in ribosome production.

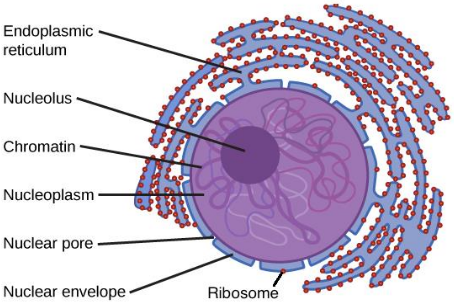


Fig. (3): The nucleolus Structural

Ribosome

Ribosomes are tiny organelles that contain RNA and specific proteins within the cytoplasm. Within the cell, ribosomes are directly involved in the manufacture of proteins by using their RNA and amino acids.

This process involves decoding the information contained in the mRNA and using amino acids to produce the required proteins.

Mitochondria

Mitochondria are some of the largest organelles within a cell. Compared to some of the other organelles, mitochondria contain DNA which makes them semiautonomous. Mitochondria also contain a double-membrane with the inner membrane folding to form cristae. Also known as the powerhouse, mitochondria play an important role in respiration where they generate ATP (adenosine triphosphate) from substrates in the presence of oxygen. Using their DNA, mitochondria are able to encode for some of the components they require to perform their functions.

ATP stores energy in the form of chemical bonds and is released whenever it is needed for various cell functions.

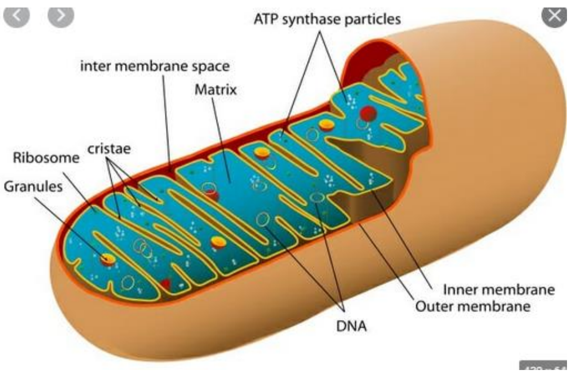


Fig. (4): The Mitochondria structural

Endoplasmic Reticulum

Found in eukaryotic cells, Endoplasmic reticulum (ER) is the organelle that forms an interconnected network of flattened sacs (cisternae). Like some of the other organelles found in eukaryotes, ER is enclosed in a membrane. The ER is divided into two regions that vary in structure and function.

These include:

Smooth endoplasmic reticulum

The smooth ER is named so because it lacks a ribosome on its surface. As a result, it is more smooth in appearance as compared to the rough ER. It is involved in the synthesis of lipids (e.g. phospholipids) and carbohydrates that are used to build the cell membrane.

Some of the other functions of the smooth ER include:

-Transportation of vesicles
- Enzyme production in the liver
- Contraction of muscle cells in the muscles
- Synthesis of hormones in the brain cells

Rough endoplasmic reticulum

Unlike the smooth ER, rough ER has ribosome attached to its surface. It's involved in the manufacture of various proteins in the cell. On the other hand, the rough ER is involved in the production of antibodies, insulin as well as transportation of proteins into the smooth ER.

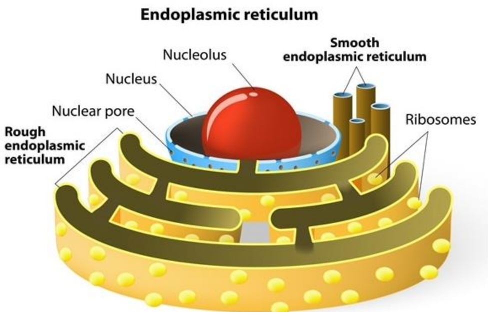


Fig. (5): Rough endoplasmic reticulum

Golgi Apparatus

Golgi apparatus are found in eukaryotic and are highly folded into cisternae (flattened sacs). They are enclosed in a membrane that varies in thickness from different regions.

In the cell, Golgi apparatus are actively involved in the manufacturing, storage as well as transportation of products from the ER.

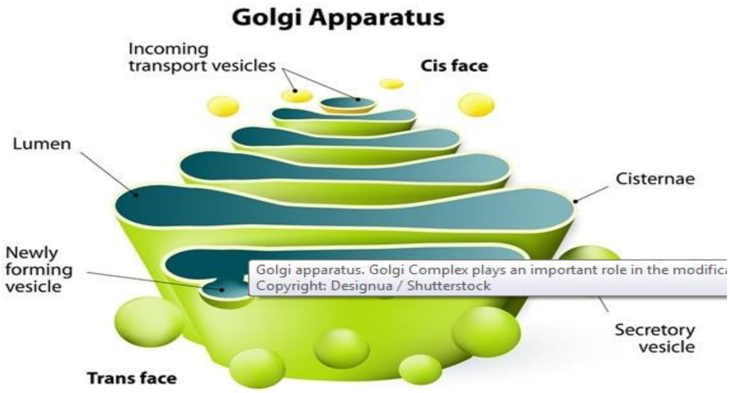


Fig. (6): Golgi Apparatus

<u>Vacuoles</u>

A vacuole may be described as a space inside the cell that does not contain cytoplasm. It is surrounded by a membrane and filled with a fluid. Vacuoles store various molecules including enzymes, waste products of the cell, water, and even food material depending on the type of cell.

In cases were vacuoles contain waste products of the cell, they are also involved in the exportation of waste from the cell thus protecting the cell from toxicity.

***** Some vacuoles also play a role in maintaining the internal hydrostatic pressure of the cell as well as regulating pH.

Cytoskeleton

The cytoskeleton is made up of microtubules and microfilaments. By spreading throughout the cell (in the cytoplasm), the cytoskeleton helps maintain the shape of the cell while also ensuring its elasticity.

***** The cytoskeleton is also involved in anchoring the nucleus and supporting cell contents.

Centriole

Centrioles are cylindrical organelles found in most eukaryotic cells. They contain tube-shaped molecules known as microtubules that help separate chromosomes and move them during cell division.

Lysosome

A lysosome is commonly referred to as sacs of enzymes. They are membranous organelles that contain acidic enzymes (hydrolase enzymes) that serve to digest various macromolecules (e.g. lipids and nucleic acids) in the cell.

Conditions inside lysosomes have been shown to be acidic. These conditions are maintained by the lysosome membrane thus providing favorable conditions for the enzymes to perform their functions.

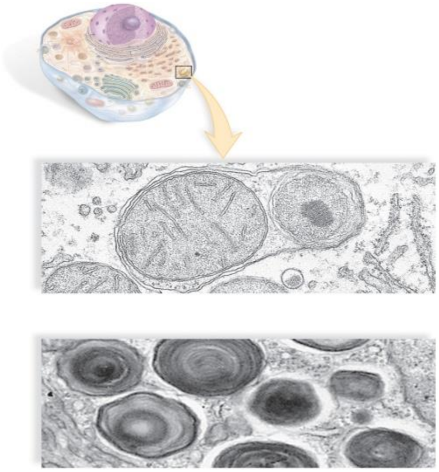


Fig. (7): lysosome

Other features of a cell include:

Cell Wall

- Some books do not consider the cell wall to be an organelle. However, it's one of the most important components of plant cells. The cell wall surrounds the cell membrane and serves to strengthen and protect the cell.

For instance, in the cells of plant roots, the cell wall protects the cell as they grow deeper in the soil. The cell wall also serves as a filter that controls the movement of molecules in and out of the cell.

Cytoplasm

is also not considered as an organelle in some books. However, it is an important component of the cell. Cell cytoplasm is composed of protoplasm in which all the other cell organelles are suspended.

Many of the cell processes (protein synthesis, respiration etc) take place in the cytoplasm. The cytoplasm also plays an important role in the movement of various materials around the cell.

Chemical Composition of the Cell

Chemical compounds in the cell can be divided into two major groups: Organic and Inorganic compounds

Organic compounds are chemical compounds that contain the element carbon. Organic compounds in the cell include carbohydrates, protein, lipids and nuclei acids. Some of these compounds are synthesized by the cell itself.

Water is an inorganic compound which is composed of hydrogen and oxygen. It is an important compound in the cell.

Table 1: inorganic chemical compounds in the cell.

Percentage of Body Weight	Element	Usage
65%	Oxygen	This element is obviously the most important element in the human body. Oxygen atoms are present in water, which is the compound most common in the body, and other compounds that make up tissues. It is also found in the blood and lungs due to respiration.
18.6%	Carbon	Carbon is found in every organic molecule in the body, as well as the waste product of respiration (carbon dioxide). It is typically ingested in food that is eaten.
9.7%	Hydrogen	Hydrogen is found in all water molecules in the body as well as many other compounds making up the various tissues.

3.2%	Nitrogen	Nitrogen is very common in proteins and organic compounds. It is also present in the lungs due to its abundance in the atmosphere.
1.8%	Calcium	Calcium is a primary component of the skeletal system, including the teeth. It is also found in the nervous system, muscles, and the blood.
1.0%	Phosphorus	This element is common in the bones and teeth, as well as nucleic acids.
0.4%	Potassium	Potassium is found in the muscles, nerves, and certain tissues.
0.2%	Sodium	Sodium is excreted in sweat, but is also found in muscles and nerves.
0.2%	Chlorine	Chlorine is present in the skin and facilitates water absorption by the cells.
0.06%	Magnesium	Magnesium serves as a cofactor for various enzymes in the body.
0.04%	Sulfur	Sulfur is present in many amino acids and proteins.
0.007%	Iron	Iron is found mostly in the blood since it facilitates the transportation of oxygen.
0.0002%	Iodine	Iodine is found in certain hormones in the thyroid gland.

The Importance of Organic Compounds in the Cell

1. **Carbohydrates**

- Supply energy for cell processes
- A means of storing energy
- Give structural support to cell walls

2. **Lipids**

- Store large amounts of energy over long periods of time
- Act as an energy source
- Play a major role in the structure of the cell membranes
- Act as a source of metabolic water
- Reduce the loss of water by evaporation

3. Proteins

- Act as building blocks of many structural components of the cell ; required for growth
- Form enzymes which catalyze chemical reactions
- Form hormones which control growth and metabolism

4. **Nucleic acids**

- Contain the genetic information of cells
- Play a vital role in protein synthesis

The importance of water in the cell

- Water is important for life because its chemical and physical properties allow it to sustain life.
- Water is a polar molecule which consists of 2 hydrogen atoms and 1 oxygen atom. A polar molecule is a molecule with an unequal distribution of charges. Each molecule has a positively charged and a negatively charged end. Polar molecules attract one another as well as ions. Because of this property, water is considered the solvent of life.
- It is the transport medium in the blood
- It acts as a medium for biochemical reactions.
- Water helps in the maintenance of a stable internal environment within a living organism. The concentration of water and inorganic salts that dissolve in water is important in maintaining the osmotic balance between the blood and interstitial fluid.
- It helps in lubrication.
- Water molecules have very high cohesion. Water molecules tend to stick to each other and move in long unbroken columns through the vascular tissues in plants.

Cell Division Definition

Cell division is the process cells go through to divide. There are several types of cell division, depending upon what type of organism is dividing. Organisms have evolved over time to have different and more complex forms of cell division. Most prokaryotes, or bacteria, use binary fission to divide the cell. Eukaryotes of all sizes use *mitosis* to divide. Sexually-reproducing eukaryotes use a special form of cell division called *meiosis* to reduce the genetic content in the cell. This is necessary in sexual reproduction because each parent must give only half of the required genetic material, otherwise the offspring would have too much DNA, which can be a problem. These different types of cell division are discussed below.

Types of Cell Division

Prokaryotic Cell Division

Prokaryotes replicate through a type of cell division known as *binary fission*. Prokaryotes are simple organism, with only one membrane and no division internally. Thus, when aprokaryote divides, it simply replicates the DNA and splits in half. The process is a little more complicated than this, as DNA must first be unwound by special proteins. Although the DNA in prokaryotes usually exists in a ring, it can get quite tangled when it is being used by the cell. To copy the DNA efficiently, it must be stretched out. This also allows the two new rings of DNA created to be separated after they are produced. The two strands of DNA separate into two different sides of the prokaryote cell. The cell then gets longer, and divides in the middle.

The DNA is the tangled line. The other components are labeled. Plasmids are small rings of DNA that also get copied during *binary fission* and can be picked up in the environment, from dead cells that break apart. These plasmids can then be further replicated. If aplasmid is beneficial, it will increase in a population. This is in part how antibiotic resistance in bacteria happens. The ribosomes are small protein structures that help produce proteins. They are also replicated so each cell can have enough to function.

Eukaryotic Cell Division: Mitosis

Eukaryotic organisms have membrane bound organelles and DNA that exists on chromosomes, which makes cell division harder. Eukaryotes must replicate their DNA, organelles, and cell mechanisms before dividing. Many of the organelles divide using a process that is essentially *binary fission*, leading scientist to believe that eukaryotes were formed by prokaryotes living inside of other prokaryotes.

After the DNA and organelles are replicated during *interphase* of the cell cycle, the eukaryote can begin the process of mitosis. The process begins during prophase, when the chromosomes condense. If mitosis proceeded without the chromosomes condensing, the DNA would become tangled and break. Eukaryotic DNA is associated with many proteins which can fold it into complex structures. As mitosis proceeds to *metaphase* the chromosomes are lined up in the middle of the cell. Each half of a chromosome, known as*sister chromatids* because they are replicated copies of each other, gets separated into each half of the cell as mitosis proceeds. At the end of mitosis, another process called *cytokinesis* divides the cell into two new daughter cells.

All eukaryotic organisms use mitosis to divide their cells. However, only single-celled organisms use mitosis as a form of reproduction. Most multicellular organisms are sexually reproducing and combine their DNA with that of another organism to reproduce. In these cases, organisms need a different method of cell division. Mitosis yields identical cells, but meiosis produces cells with half the genetic information of a regular cell, allowing two cells from different organisms of the same species to combine.

Eukaryotic Cell Division: Meiosis

In sexually reproducing animals, it is usually necessary to reduce the genetic information before fertilization. Some plants can exist with too many copies of the genetic code, but in most organisms it is highly detrimental to have too many copies. Humans with even one extra copy of one chromosome can experience detrimental changes to their body. To counteract this, sexually reproducing organisms undergo a type of cell division known as meiosis. As before mitosis, the DNA and organelles are replicated. The process of meiosis contains two different cell divisions, which happen back-to-back. The first meiosis, meiosis*I* separates homologous chromosomes. The homologous chromosomes present in a cell represent the two alleles of each gene an organism has. These alleles are recombined and separated, so the resulting daughter cells have only one allele for each gene, and no homologous pairs of chromosomes. The second division, *meiosis II*, separated the two copies of DNA, much like in mitosis. The end result of meiosis in one cell is 4 cells, each with only one copy of the genome, which is half the normal number.

Organisms typically package these cells into *gametes*, which can travel into the environment to find other gametes. When two gametes of the right type meet, one will fertilize the other and produce a *zygote*. The zygote is a single cell that will undergo mitosis to produce the millions of cells necessary for a large organism. Thus, most eukaryotes use both mitosis and meiosis, but at different stages of their lifecycle.

Cell Division Stages

Depending upon which type of cell division an organism uses, the stages can be slightly different.

Mitosis Stages

Mitosis starts with *prophase* in which the chromosome is condensed. The cell proceeds to *metaphase* where the chromosomes are aligned on the metaphase plate. Then the chromosomes are separated in *anaphase* and the cell's cytoplasm is pinched apart during *telophase*. *Cytokinesis* is the final process that breaks the cell membrane and divides the cell into two.

Meiosis Stages

The stages of meiosis are similar to mitosis, but the chromosomes act differently. Meiosis has two phases, which include two separate cell divisions without the DNA replicating between them. *Meiosis I* and *meiosis II* have the same 4 stages as mitosis: prophase, metaphase, anaphase, and telophase. Cytokinesis concludes both rounds of meiosis.

In prophase I, the chromosomes are condensed. In metaphase I, the chromosomes line up across from their homologous pairs. When they are separated in anaphase I and telophase I, there is only one form of each gene in each cell, known as a reduction division. Meiosis II proceeds in the same manner as mitosis, which sister chromatids dividing on the metaphase plate. By telophase II, there are 4 cells, each with half of the alleles as the parent cell and only a single copy of the genome. The cells can now become gametes and fuse together to create new organisms.

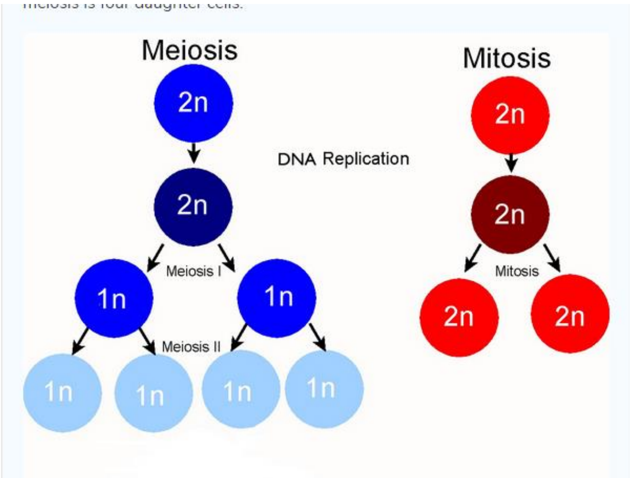


Fig.(8): Types of Cell Division

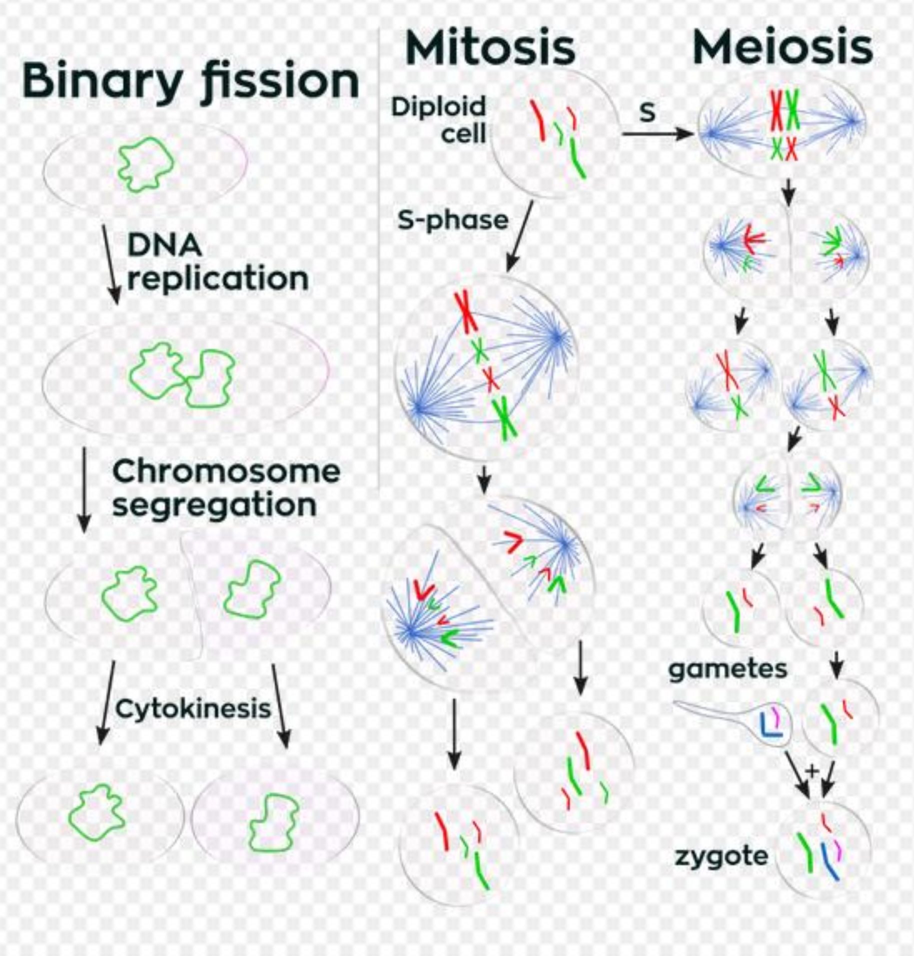


Fig.(9): Types of Cell Division

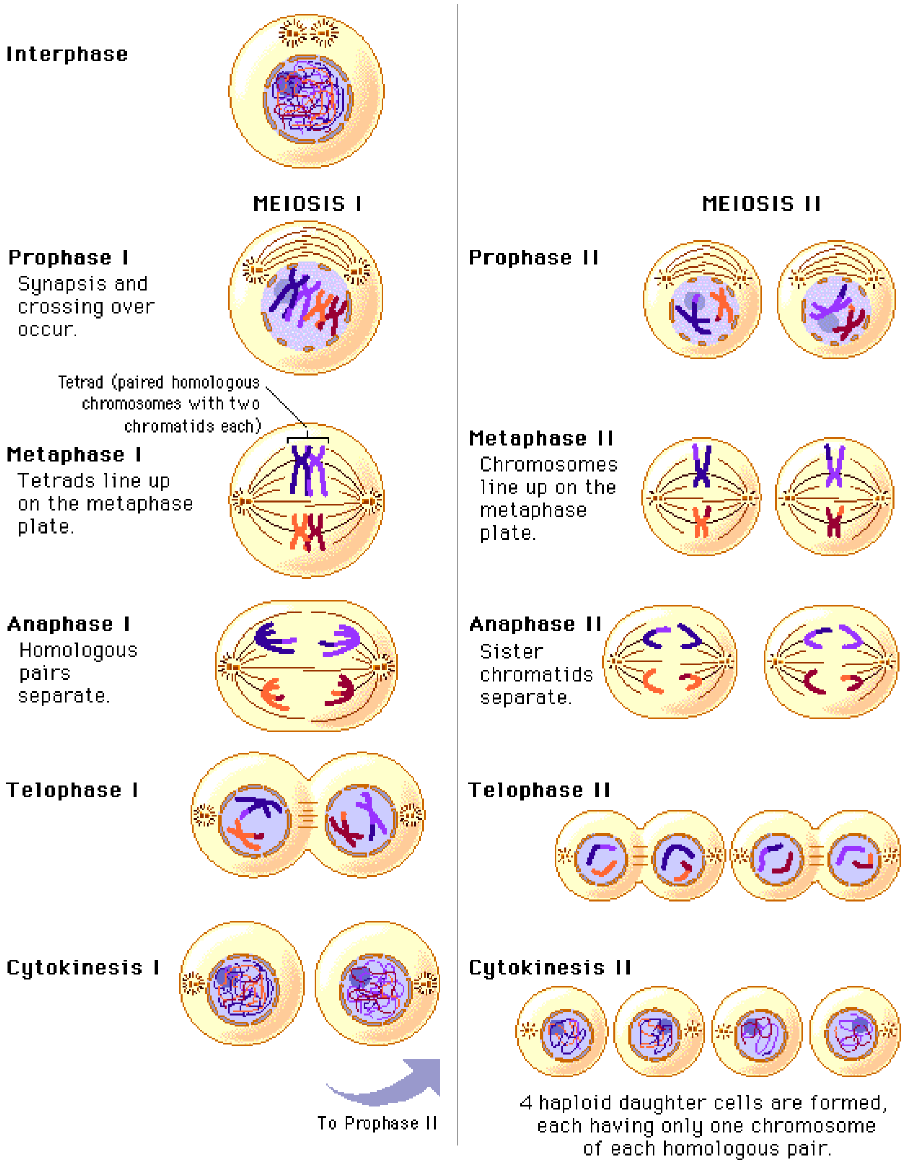


Fig.(10): Cell Division

Part 2

Tissues

Tissues

Cells work together in functionally related groups called tissues

Types of tissues:

1- Epithelial – lining and covering
2-Connective – support
3-Muscle – movement
4-Nervous – control

Epithelial Tissue

General Characteristics & Functions

Covers a body surface or lines a body cavity
Forms most glands

Functions of epithelium
-Protection
-Absorption, secretion, and diffusion
-Filtration
-Forms slippery surfaces (mucus secretion)

Classifications of Epithelia

First name of tissue indicates number of layers
Simple – one layer of cells

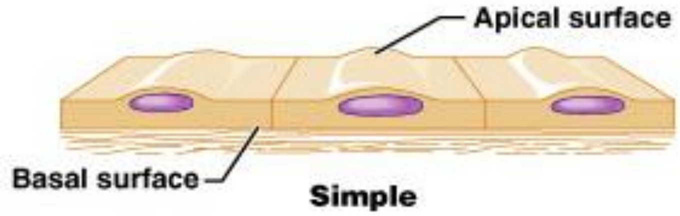


Fig. (11): Simple Epithelia cells

***Stratified – more than one layer of cells**

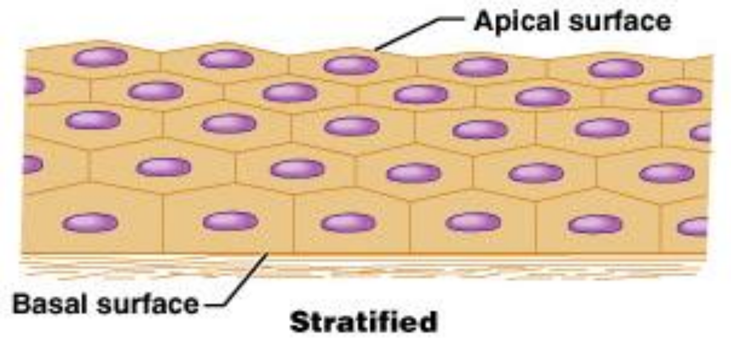


Fig. (12): Stratified – Epithelia cells

***Last name of tissue describes shape of cells**
Squamous – cells wider than
tall (plate or “scale” like)

Fig. (13): Squamous cells

***Cuboidal – cells are as wide as tall, as in cubes**

Fig. (14): Cuboidal cells

***Columnar – cells are taller than they are wide, like columns.**

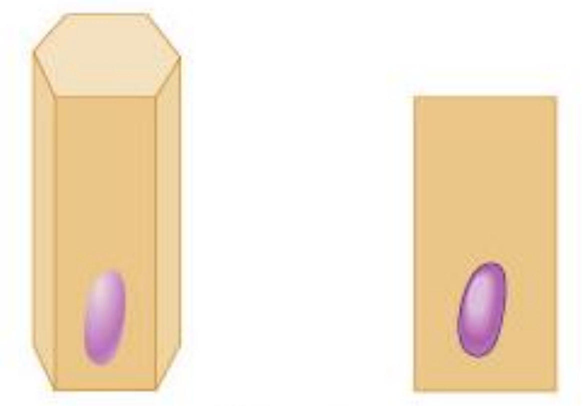


Fig. (15): Columnar – cells

Naming Epithelia

Naming the epithelia includes both the layers (first) and the shape of the cells (second)
i.e. stratified cuboidal epithelium
The name may also include any accessory

structures

Goblet cells
Cilia
Keratin

Simple Squamous Epithelium
Description
single layer of flat cells with disc-shaped nuclei, Special types

Endothelium (inner covering) slick lining of hollow organs

Mesothelium (middle covering)
Lines peritoneal, pleural, and pericardial cavities Covers visceral organs of those cavities

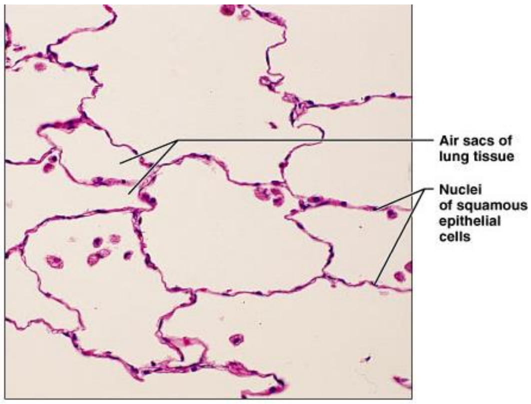
Function

Passage of materials by passive diffusion and filtration

Secretes lubricating substances in serous membranes

Location

-Renal corpuscles (kidneys)
-Alveoli of lungs
-Lining of heart, blood and lymphatic vessels
-Lining of ventral body cavity (serosae/serous memb.)



Photomicrograph: Simple squamous epithelium forming part of the alveolar (air sac) walls (400×).

Fig. (16): **Simple Squamous Epithelium**

Simple Cuboidal Epithelium

Description

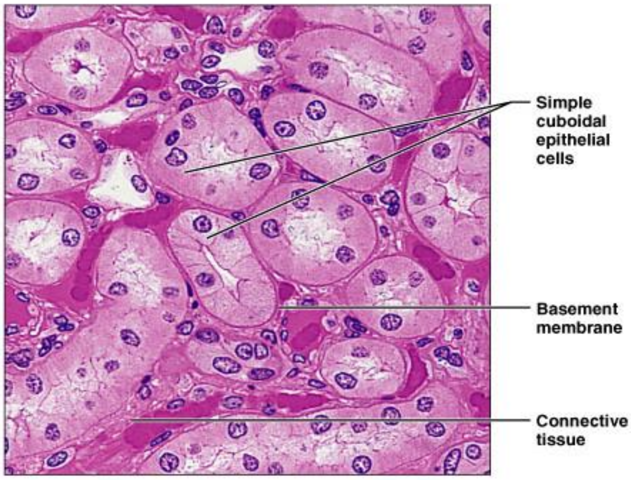
single layer of cube-like cells with large, spherical central nuclei

Function

secretion and absorption

Location

kidney tubules, secretory portions of small glands, ovary surface



Photomicrograph: Simple cuboidal epithelium in kidney tubules (400×).

Fig. (17): Simple Cuboidal Epithelium

<u>Simple Columnar Epithelium</u>

Description

single layer of column-shaped (rectangular) cells with oval nuclei
Some bear cilia at their apical surface
May contain goblet cells

Function

Absorption; secretion of mucus, enzymes, and other substances
Ciliated type propels mucus or reproductive cells by ciliary action

Location
Non-ciliated form
-Lines digestive tract, gallbladder, ducts of -
some glands

-

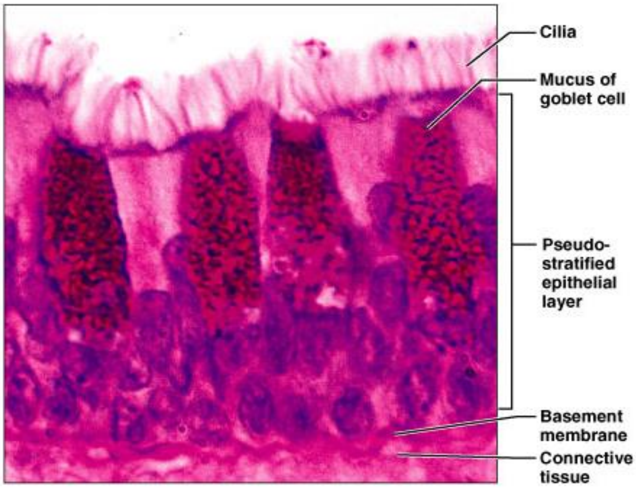
Photomicrograph: Simple columnar epithelium of the stomach mucosa (1300×).

F**ig. (18): Simple Columnar Epithelium**

Ciliated Columnar Epithelium
Lines small bronchi,
Description
-All cells originate at basement membrane
-Only tall cells reach the apical surface
-May contain goblet cells and bear cilia
-Nuclei lie at varying heights within cells
Gives false impression of stratification

Function

Secretion of mucus; propulsion of mucus by cilia



Photomicrograph: Pseudostratified ciliated columnar epithelium lining the human trachea (400×).

Fig. (19): ciliated Simple Columnar Epithelium

<u>Stratified Epithelial cell</u>

Contain two or more layers of cells
Regenerate from below
Major role is protection
Are named according to the shape of cells at apical layer

Stratified Squamous Epithelium
Description

Many layers of cells – squamous in shape

Deeper layers of cells appear cuboidal or columnar
Thickest epithelial tissue – adapted for protection

Function
Protects underlying tissues in areas subject to abrasion
Location
Keratinized – forms epidermis
Non-keratinized – forms lining of esophagus, mouth, and vagina

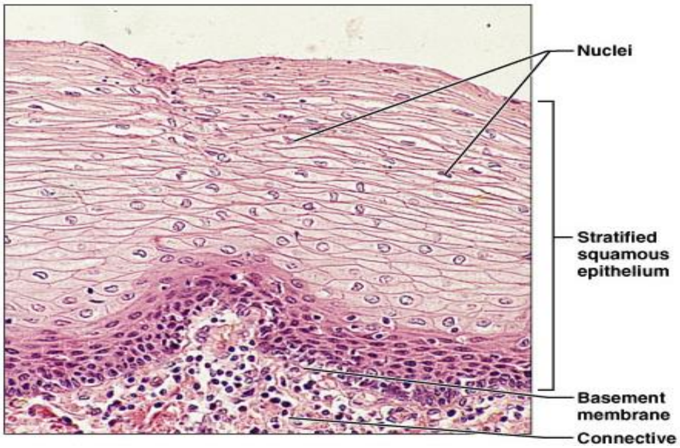


Fig. (20): Stratified Squamous Epithelium

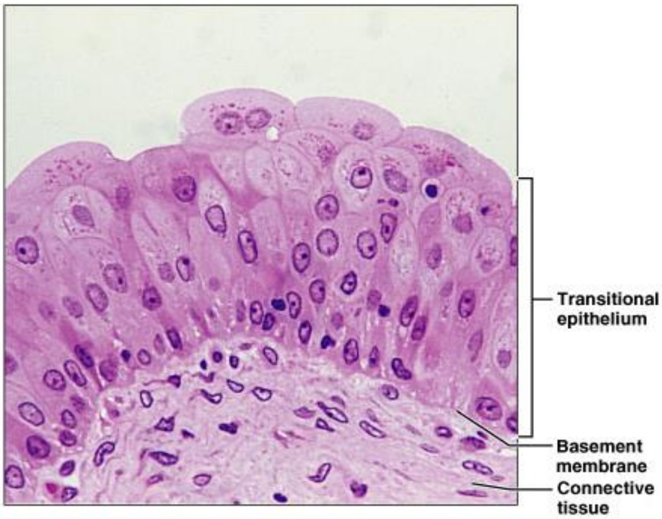
Transitional Epithelium

Description
Basal cells usually cuboidal or columnar
Superficial cells dome-shaped or squamous

Function
stretches and permits distension of urinary bladder

Location

Lines ureters, urinary bladder and part of urethra



Photomicrograph: Transitional epithelium lining of the bladder, relaxed state (500×); note the bulbous, or rounded, appearance of the cells at the surface; these cells flatten and become elongated when the bladder is filled with urine.

Fig. (21): Transitional Epithelium

<u>Connective Tissue</u>

Most diverse and abundant tissue

Main classes

-Connective tissue proper
-Cartilage
-Bone tissue
-Blood

Components of connective tissue:

-Cells (varies according to tissue)
-Matrix

-Fibers (varies according to tissue)
-Ground substance (varies according to tissue) dermatin sulfate, hyaluronic acid, keratin sulfate, chondroitin sulfate…

Common embryonic origin
– mesenchyme

<u>Connective Tissue Proper</u>
-Loose Connective Tissue
-Areolar
-Reticular
-Adipose
-Dense Connective Tissue
-Regular
-Irregular
-Elastic

<u>Areolar Connective Tissue</u>
Description
-Gel-like matrix with:
all three fiber types (collagen, reticular, elastic) for support
-Ground substance is made up by glycoproteins also made and secreted by the fibroblasts.
Cells – fibroblasts, macrophages, mast cells, white blood cells
Function
-Wraps and cushions organs
-Holds and conveys tissue fluid

-Important role in inflammation Main battlefield in fight against infection
-Defenders gather at infection sites
Macrophages
Plasma cells
Mast cells
Neutrophils, lymphocytes, and eosinophils
Location
-Widely distributed under epithelia
-Packages organs
Surrounds capillaries

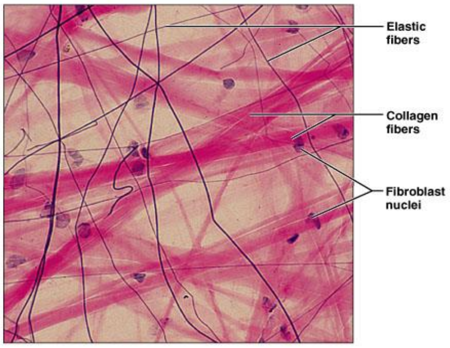


Fig. (22): Areolar Connective Tissue

<u>Adipose Tissue</u>

Description
Closely packed adipocytes
Have nucleus pushed to one side by fat droplet

Function
Provides reserve food fuel
Insulates against heat loss
Supports and protects organs

Location

Under skin
Around kidneys
Behind eyeballs, within abdomen and in breasts

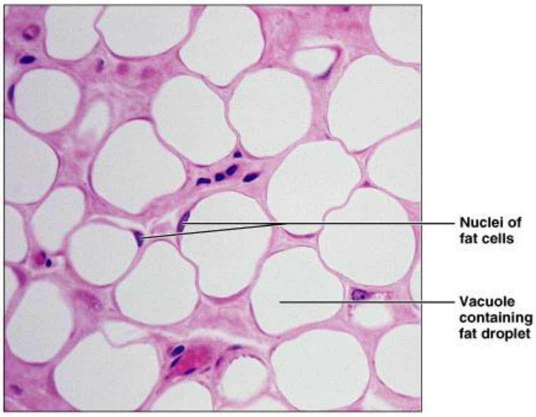


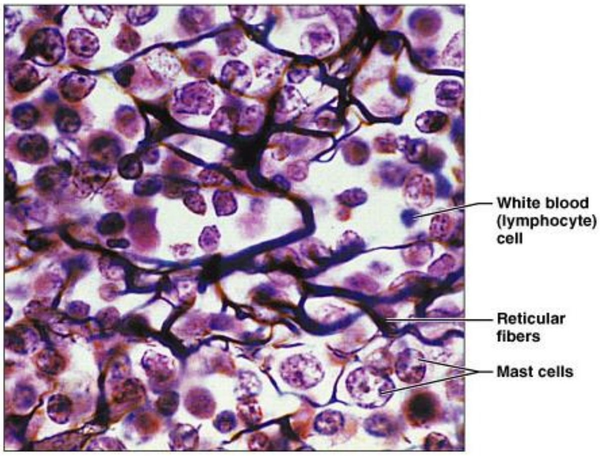
Fig. (23): Adipose Tissue

<u>Reticular Connective Tissue</u>

Description
– network of reticular fibers in loose ground substance

Function
– form a soft, internal skeleton (stroma) – supports other cell types

Location
– lymphoid organs
- Lymph nodes, bone marrow, and spleen



Photomicrograph: Dark-staining network of reticular connective tissue fibers forming the internal skeleton of the spleen (350×).

Fig. (24): Reticular Connective Tissue

<u>Dense Regular Connective Tissue</u>

Description
Primarily *parallel* collagen fibers
Fibroblasts and some elastic fibers
Poorly vascularized

Function
Attaches muscle to bone
Attaches bone to bone
Withstands great stress in one direction

Location
Tendons and ligaments
Aponeuroses
Fascia around muscl

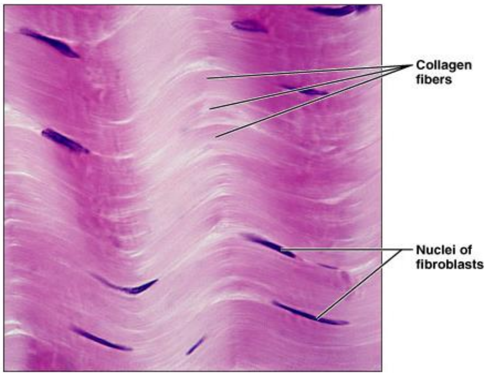


Fig. (25): Dense Regular Connective Tissue

Cartilage

Characteristics:
Firm, flexible tissue
Contains no blood vessels or nerves
Matrix contains up to 80% water
Cell type – chondrocyte

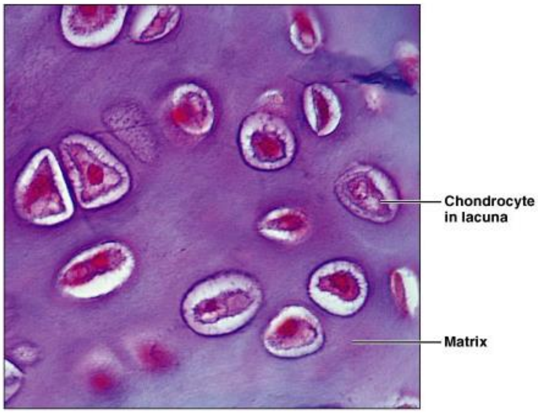
Types:
Hyaline
Elastic
Fibrocartilage

Hyaline Cartilage

Description
Imperceptible collagen fibers (hyaline = glassy)
Chodroblasts produce matrix
Chondrocytes lie in lacunae

Function
-Supports and reinforces
-Resilient cushion
-Resists repetitive stress

Location
Fetal skeleton
Ends of long bones
Costal cartilage of ribs
Cartilages of nose, trachea, and larynx



Photomicrograph: Hyaline cartilage from the trachea (300×).

Fig. (26): Hyaline Cartilage

Elastic Cartilage

Description
Similar to hyaline cartilage
More elastic fibers in matrix

Function
-Maintains shape of structure
-Allows great flexibility
Location
-Supports external ear
-Epiglottis

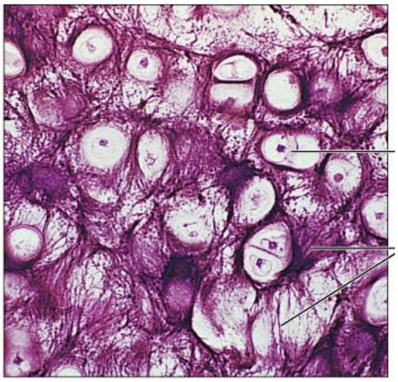


Fig. (27): Elastic Cartilage

Fibrocartilage

Description
Matrix similar, but less firm than hyaline cartilage
Thick collagen fibers predominate

Function
Tensile strength and ability to absorb compressive shock

Location
Intervertebral discs

Pubic symphysis
Discs of knee joint

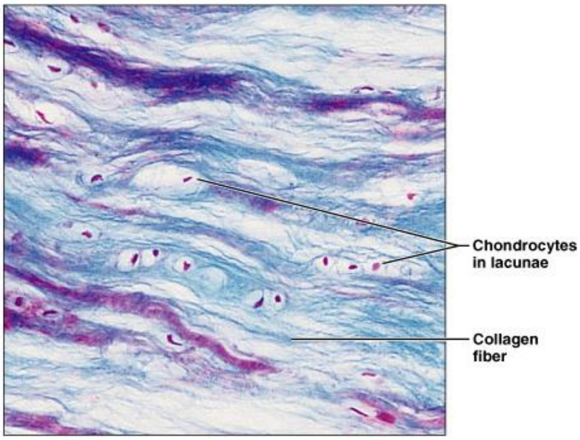


Fig. (28): Fibrocartilage

Bone Tissue

Function
-Supports and protects organs
-Provides levers and attachment site for muscles
-Stores calcium and other minerals
-Stores fat
-Marrow is site for blood cell formation

Location
Bones

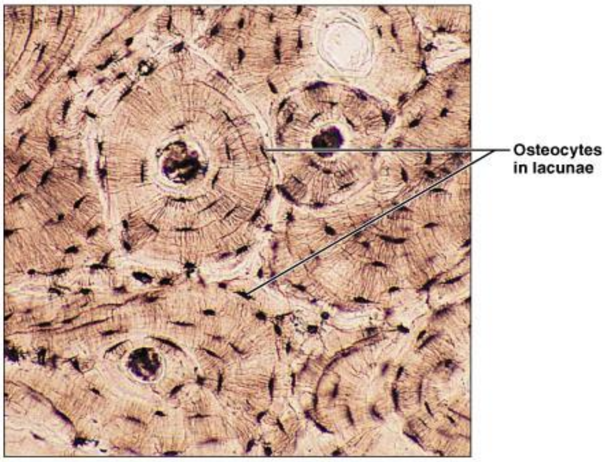


Fig. (29) Bone Tissue
:

<u>Blood Tissue</u>

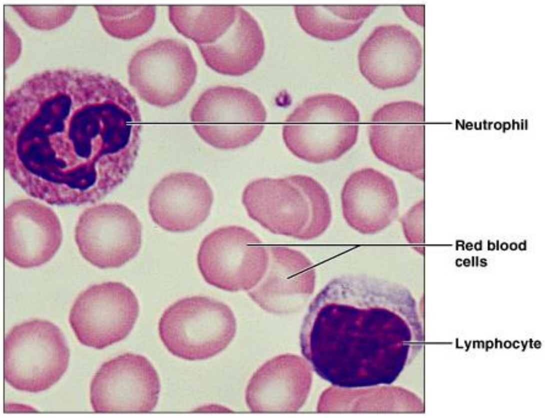
Description
red and white blood cells
in a fluid matrix

Function
-transport of respiratory gases, nutrients, and wastes

Location
within blood vessels

Characteristics

An atypical connective tissue
Develops from mesenchyme
Consists of cells surrounded by nonliving matrix



Photomicrograph: Smear of human blood (1500×); two white blood cells (neutrophil in upper left and lymphocyte in lower right) are seen surrounded by red blood cells.

Fig. (30): Blood Tissue

Muscle Tissue

Types
-Skeletal muscle tissue
-Cardiac muscle tissue
-Smooth muscle tissue

Skeletal Muscle Tissue

Characteristics
Long, cylindrical cells, Multinucleate Obvious striations

Function
Voluntary movement
Manipulation environment

Facial expression

Location

Skeletal muscles attached to bones (occasionally to skin)

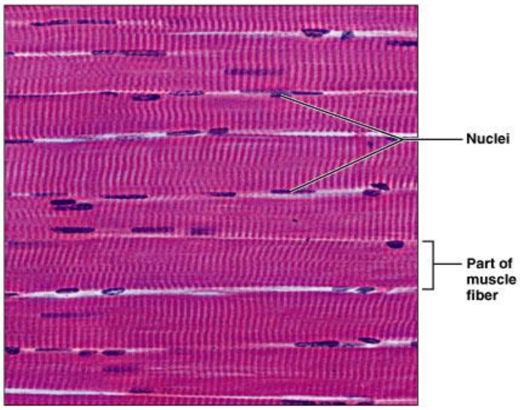


Fig. (31): Skeletal Muscle Tissu

<u>Cardiac Muscle Tissue</u>

Function

Contracts to propel blood into circulatory system

Characteristics

Branching cells, Uninucleate, Striations Intercalated discs

Location

Occurs in walls of heart

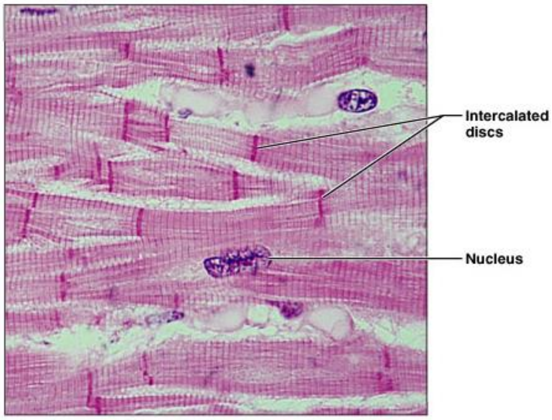


Fig. (32): Cardiac Muscle Tissue

Smooth Muscle Tissue

Characteristics
Spindle-shaped cells with central nuclei
Arranged closely to form sheets
No striations

Function
Propels substances along internal passageways
Involuntary control

Location
Mostly walls of hollow organs

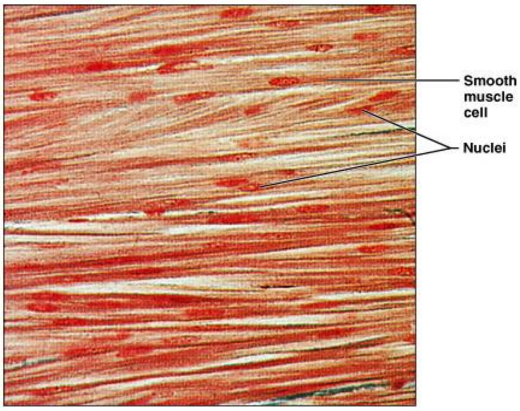


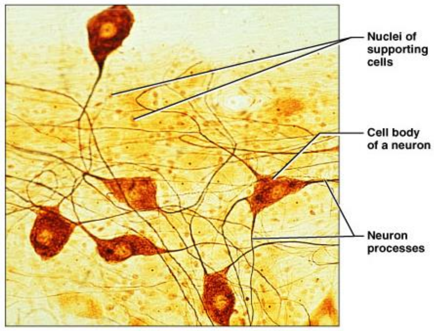
Fig. (33): Smooth Muscle Tissue

Nervous Tissue

Function
Transmit electrical signals from sensory receptors to effectors.
Location
Brain, spinal cord, and nerves

Description
Main components are brain,
spinal cord, and nerves
Contains two types of cells
Neurons – excitatory cells

Supporting cells (neuroglial cells)



Photomicrograph: Neurons (100×)

Fig. (34): Nervous Tissue

: References

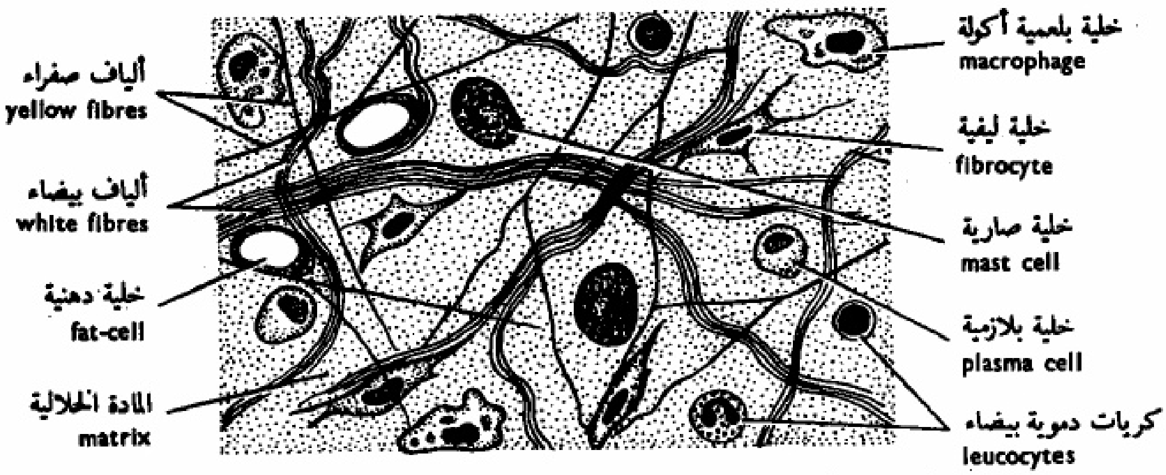
;.El-Banhawy, M. A.; Demian, E. S -1
,Shalaby, A. A.; Roshdy, M. A.; Saoud
M. F. A. and Said, E. (1998): Text Book
of Zoology. 8 th eds. Dar Al-Maaref, 1119
.Corniche El Nile, Cairo

Kuehnl, W (2003): Color atlas of -2
cytology, histology, and microscopic
anatomy, 4 th edit., rev. and enl. Thieme
.Stuttgart. New York
Lőw, P; Molnár, K and Kriska, G -3
Atlas of animal anatomy and :(2016)
histology. 1 st edit. Springer International
.Publishing
Sajonski, H.; Smollich, A. and -4
.Lindner, D. (1969): Cells and tissues
Introduction to cytology and histology for
students in the medical and biological
.sciences

الأنسجة الضامة

1-الأنسجة الضامة الأصيلة:

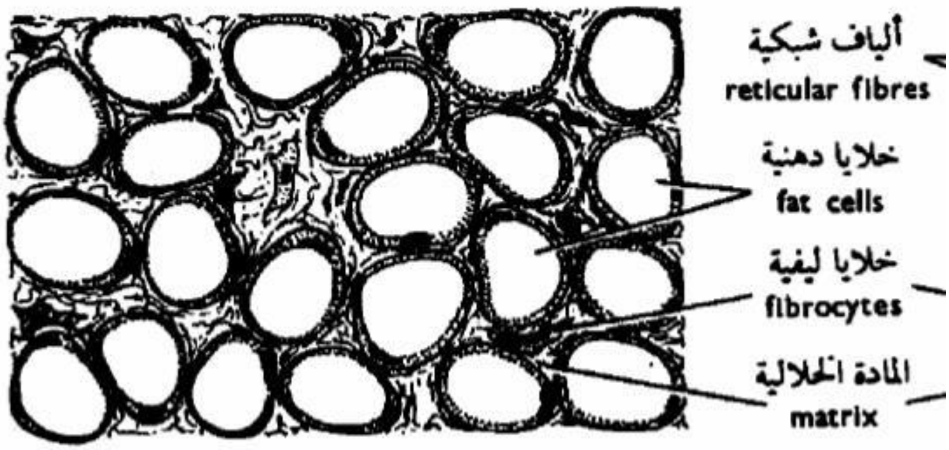
أ- النسيج الضام الفجوي (شكل 1):



Areolar connective tissue نسيج ضام فجوى
(From subcutaneous layer) (من الطبقة تحت الجلد

شكل 1

ب- النسيج الضام الدهني (شكل 2):



نسيج ضام دهني
Adipose connective tissue
(S. of Fat-body قطاع من الجسم الدهني)

شكل 2

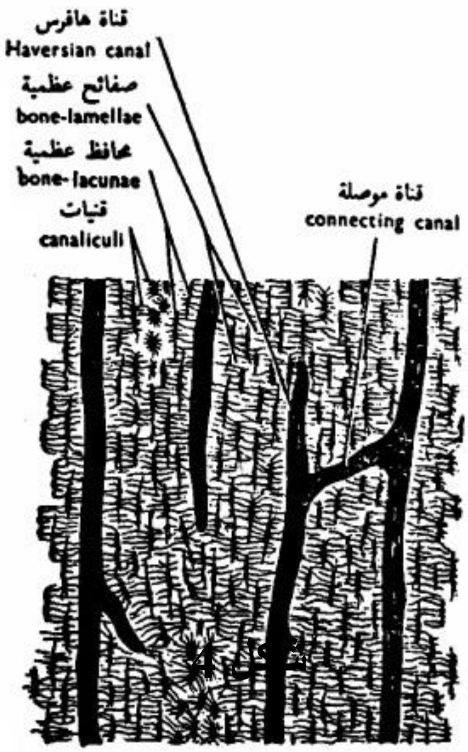
2-الأنسجة الضامة الهيكليه:

أ- الغضروف الزجاجي (شكل 3)

شكل 3

ب-قطاع طولي من عظم كثيف (شكل 4):

غضروف زجاجى
Hyaline cartilage
(من القصبة الهوائية)
(From Trachea)

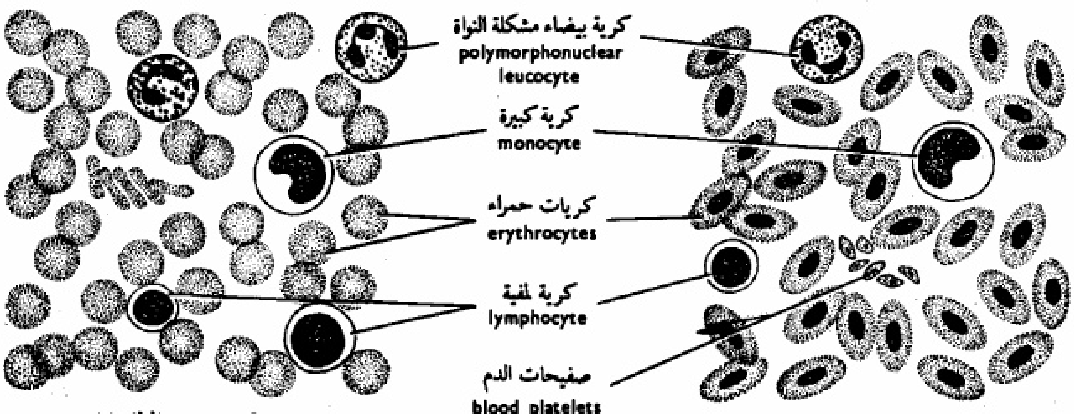


قطاع طولى من عظم كثيف
L.S. of Dense Bone

3- الأنسجة الضامة الوعائية:

أ- سحبة من دم إنسان (شكل 5):

ب- سحبة من دم ضفدعة (شكل 6):



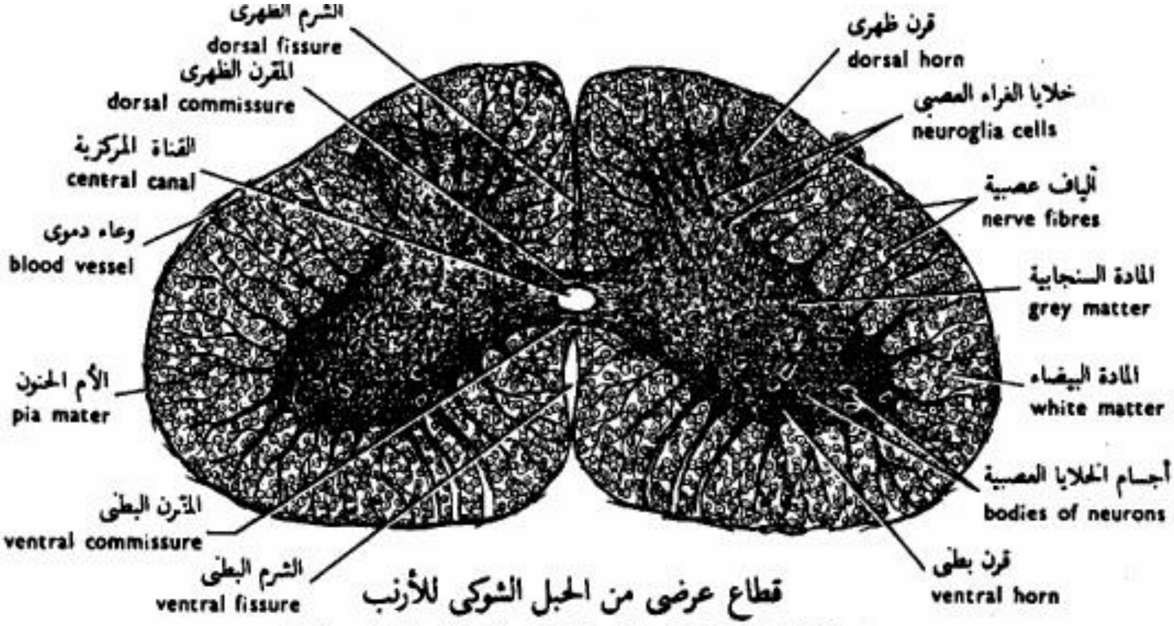
سحبة من دم الضفدعة
Film of blood of the toad
شكل 5

سحبة من دم الإنسان
Film of blood of man
شكل 6

<u>الأنسجة العصبية</u>

قطاع عرضي من الحبل الشوكي للأرنب (شكل 7):

شكل 7



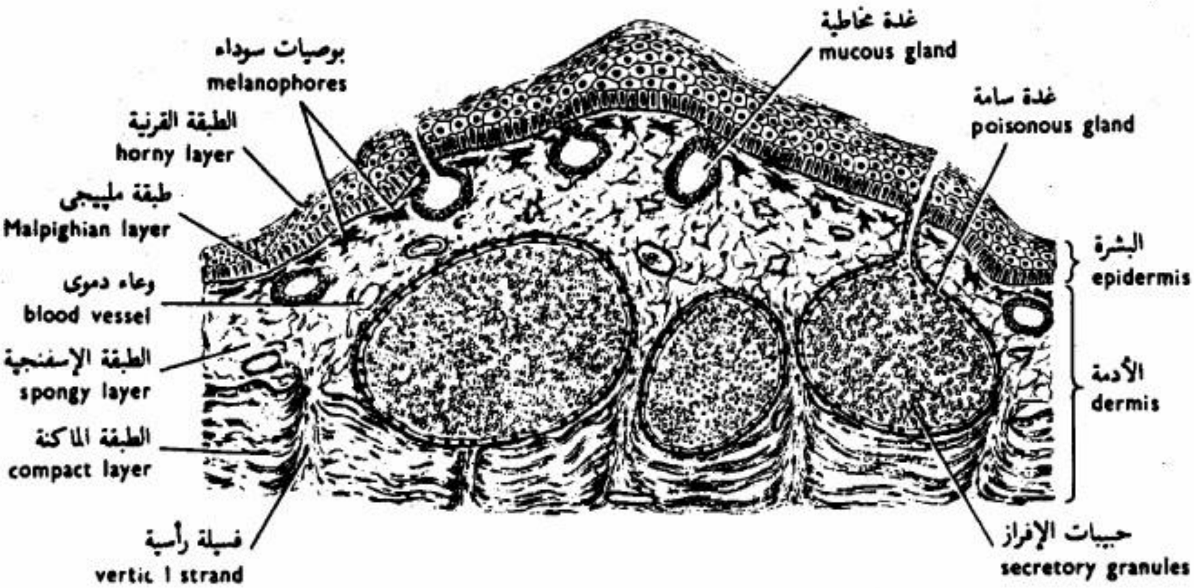
قطاع عرضى من الحبل الشوكى للأرنب

T.S. of the Spinal Cord of the Rabbit

الأعضاء

1-الجلد:

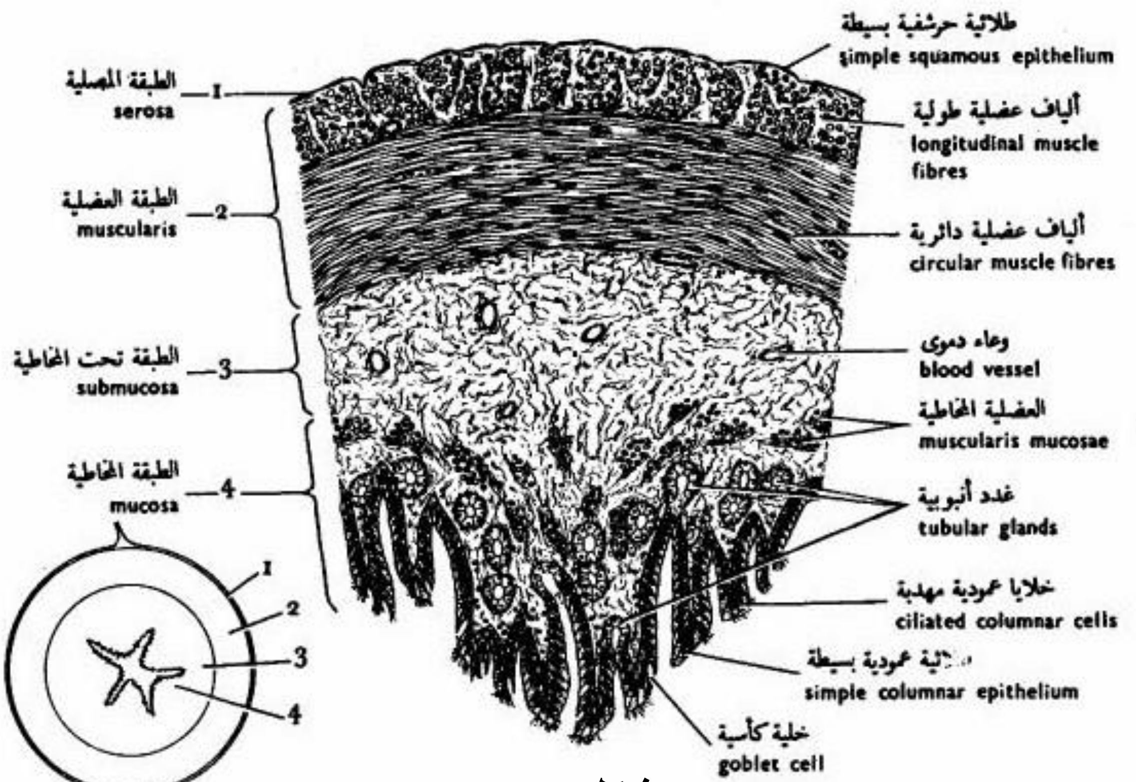
قطاع رأسي من جلد الضفدعة (شكل 8):



شكل 8

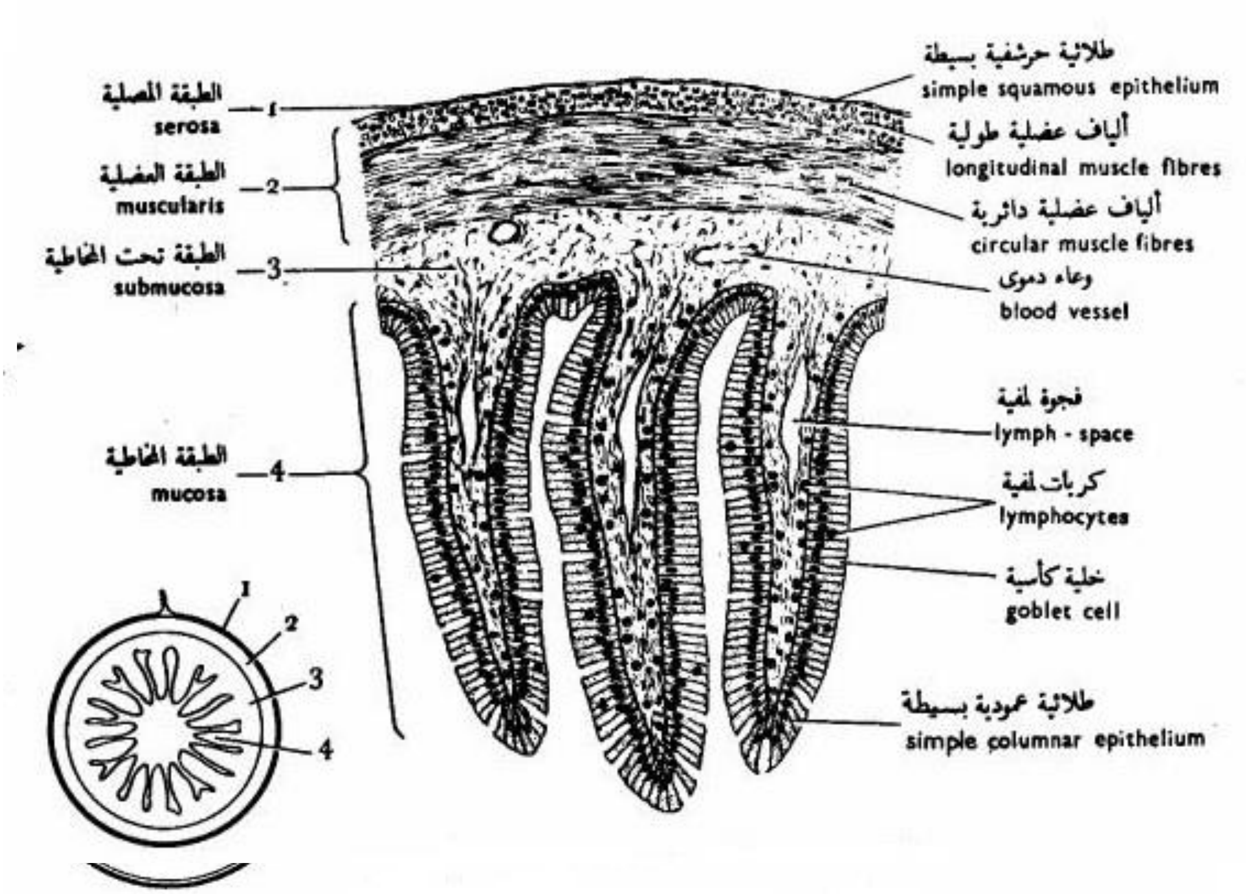
2-أعضاء الهضم (القناة الهضمية):

أ- قطاع عرضي من مرئ الضفدعة (شكل 9):



شكل 9

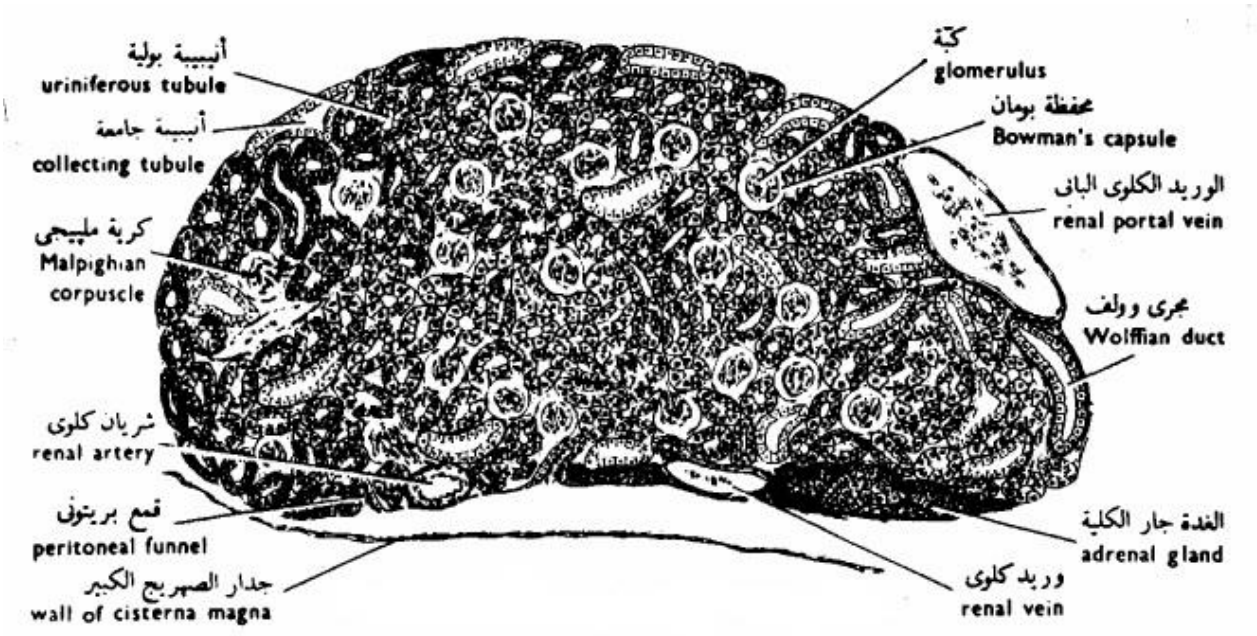
ب- قطاع عرضي من معدة الضفدعة (شكل 10):



ج- قطاع عرضي من لفائفي الضفدعة (شكل 11):

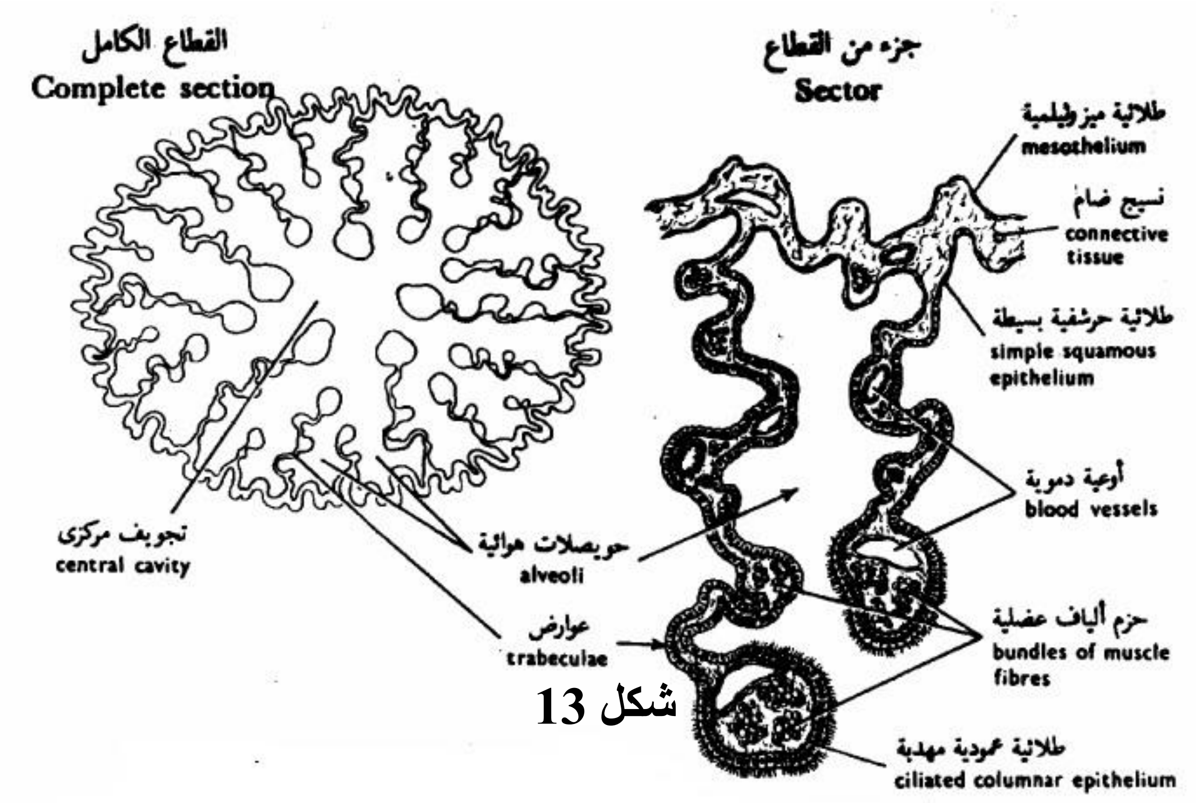
3-الأعضاء البولية:

قطاع عرضي من كلية الضفدعة (شكل 12):



4-أعضاء التنفس:

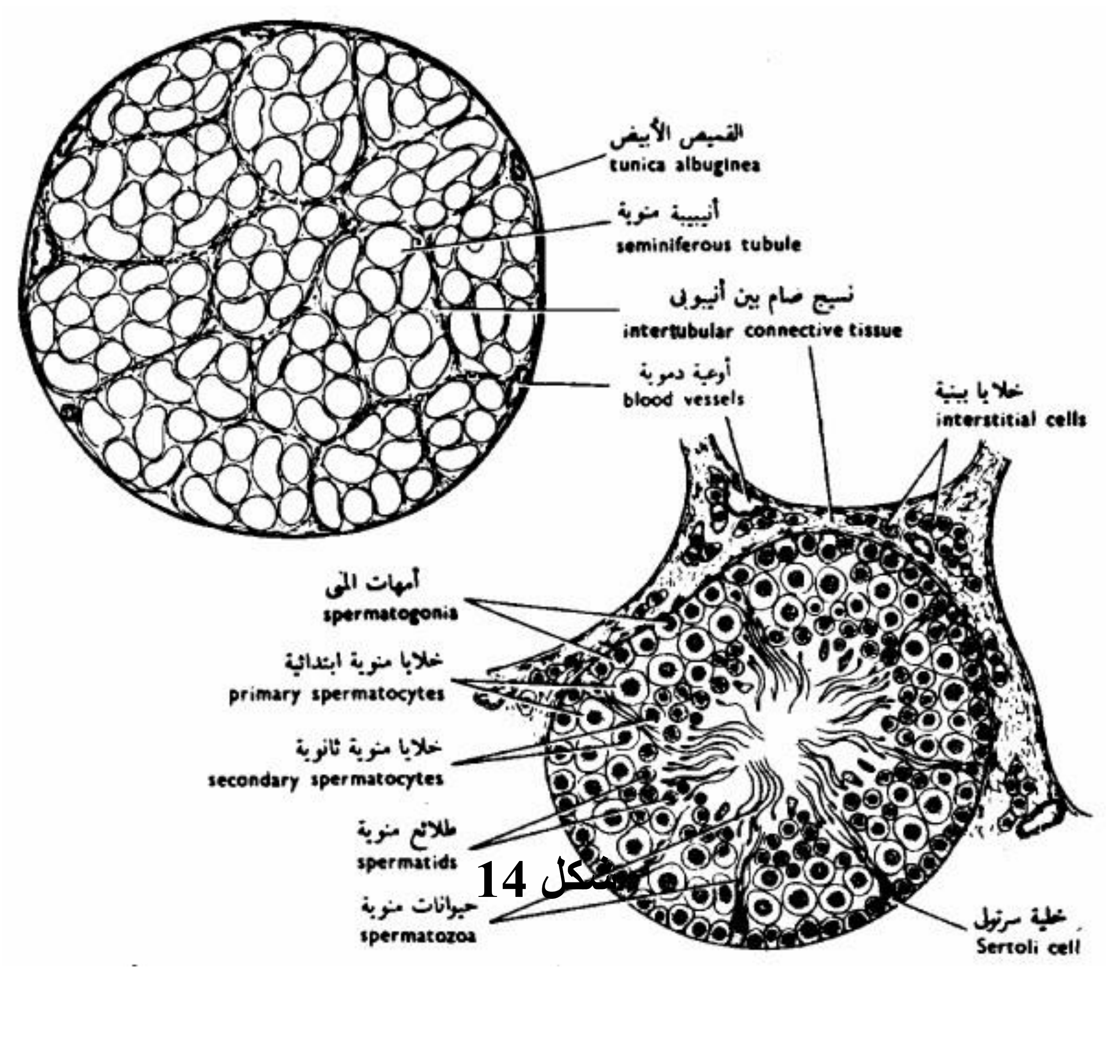
قطاع عرضي من رئـة الضفدعة (شكل 13):



شكل 13

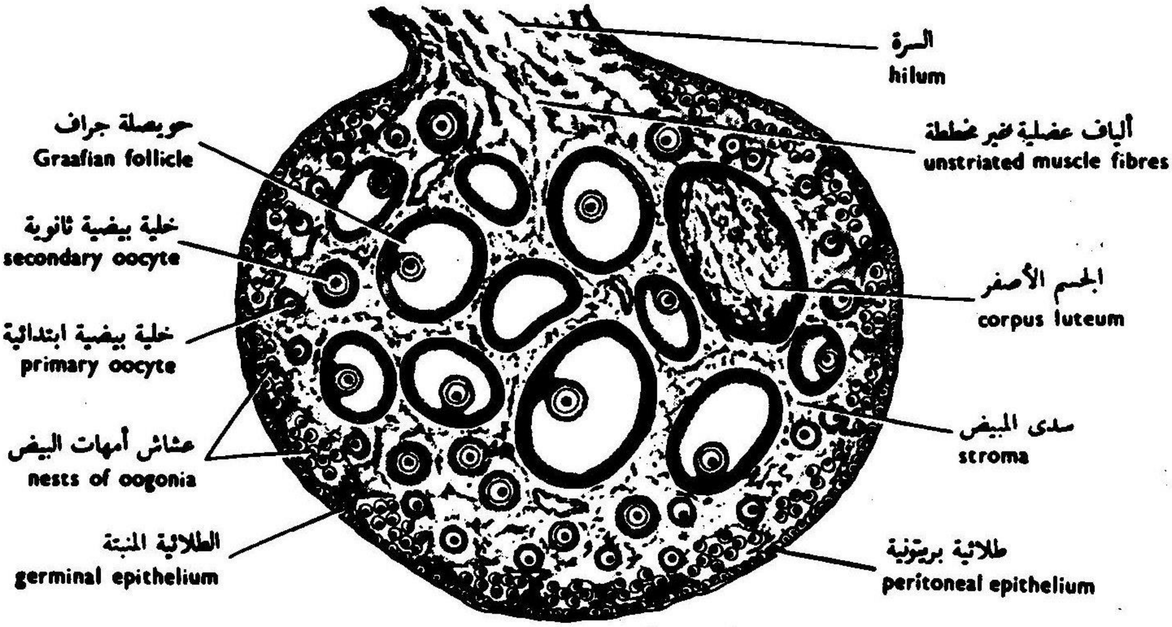
5-أعضاء التنـاسل:

أ- قطاع عرضي من خصية فأر (شكل 14):



شكل 14

ب- قطاع عرضي من مبيض قطة (شكل 15):



شكل 15

المراجع

بيولوجية الحيوان العملية باللغتين العربية والإنجليزية – الضفدعة (مع مقدمة في هستولوجية وأجنة الفقاريات) – الطبعة العاشرة : للدكتور أحمد حماد الحسيني والدكتور إميل شنودة دميان ، القاهرة (مصر): دار المعارف 1977.